APPENDIX I

CONCRETE TESTING

PREPARED BY AET

2016

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AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

March 29, 2016

Ms. Denita Lemmon
Miller Dunwiddie Architecture, Inc.
123 N 3rd Street, Suite 104
Minneapolis, MN 55401-1657

RE: Peavey Plaza Fountain Rehab
Nicollet Mall
Between 11th and 12th Streets South
Minneapolis, Minnesota
Thin Section Analysis
AET Project No. 05-06658

Dear Ms. Lemmon,

This report presents the results of our petrographic examination of thin sections produced from the three concrete core samples submitted to us by Ms. Denita Lemmon of Miller Dunwiddie Architecture, Inc. on March 23, 2015. The 95mm (3-3/4") diameter cores were labeled 1 - Retaining Wall Near 12th Street, 2 – Exterior Wall of Lower Pool, and 3- Elevated Waterfall Feature; and measured 121mm (4-3/4"), 197mm (7-3/4"), and 178mm (7") in length, respectively. We understand the concrete represented by the three core samples was produced as part of the original construction of the fountain in 1975.

Conclusions

1. Each of the concretes was placed at a similar moderate to low water-to-cement ratio; estimated to be between 0.40 to 0.45 with 4 to 9% residual unhydrated portland cement particles. The presence of mineral admixtures or pozzolanic admixtures was not detected in any of the samples. Secondary ettringite observed in samples 2 and 3 is an indication that the concretes have been saturated for significant periods of time after initial set of the concrete. Further, hydration of the portland cement grains was also more advanced in samples 2 and 3. The concrete in each of the three cores was in good condition. Carbonation in all three samples was relatively shallow for the age of the concrete.

2. Iron oxide staining observed at the outer surface of core 3 exhibited a profile, in thin section and in lapped profile, indicative of acidic attack. The top approximately 0.5 mm of the paste was very friable and was stained reddish-brown to orange-brown. The stain appears to have been produced by a combination of oxidation of iron bearing minerals within the fine aggregate and from the ferrite (iron phase) present in the portland cement. In thin section, this paste is opaque (black) when viewed with cross-polarized light and occurs directly over carbonated paste. The acid attack may be due to exposer to mildly acidic rain water; however, similar profiles have also been produced by exposure to very soft water.

Procedures

A profile of each concrete was saw-cut and lapped for visual inspection. The water/cementitious of the concrete was estimated by viewing a thin section, produced from each concrete, under a Nikon E600 polarizing light microscope at magnifications of up to 1000x. Thin section analysis was performed in accordance with Standard Operating Procedure 24-LAB-009, "Determining the Water/Cement of Portland Cement Concrete, AET Method." An additional, smaller, sawcut subdivision of each concrete sample is epoxy impregnated, highly polished, and then attached to a glass slide using an optically clear epoxy. Excess sample is sawcut from the glass and the thin slice remaining on the slide is lapped and polished until the concrete reaches 25 microns or less in thickness. Thin section analysis allows for the observation of portland cement morphology, including: phase identification, an estimate of the amount of residual material, and spatial relationships. Also, the presence and relative amounts of supplementary cementitious materials and pozzolans may be identified and estimated.

The concrete samples will be retained for a period of 30 days and then will be discarded unless we are otherwise notified.

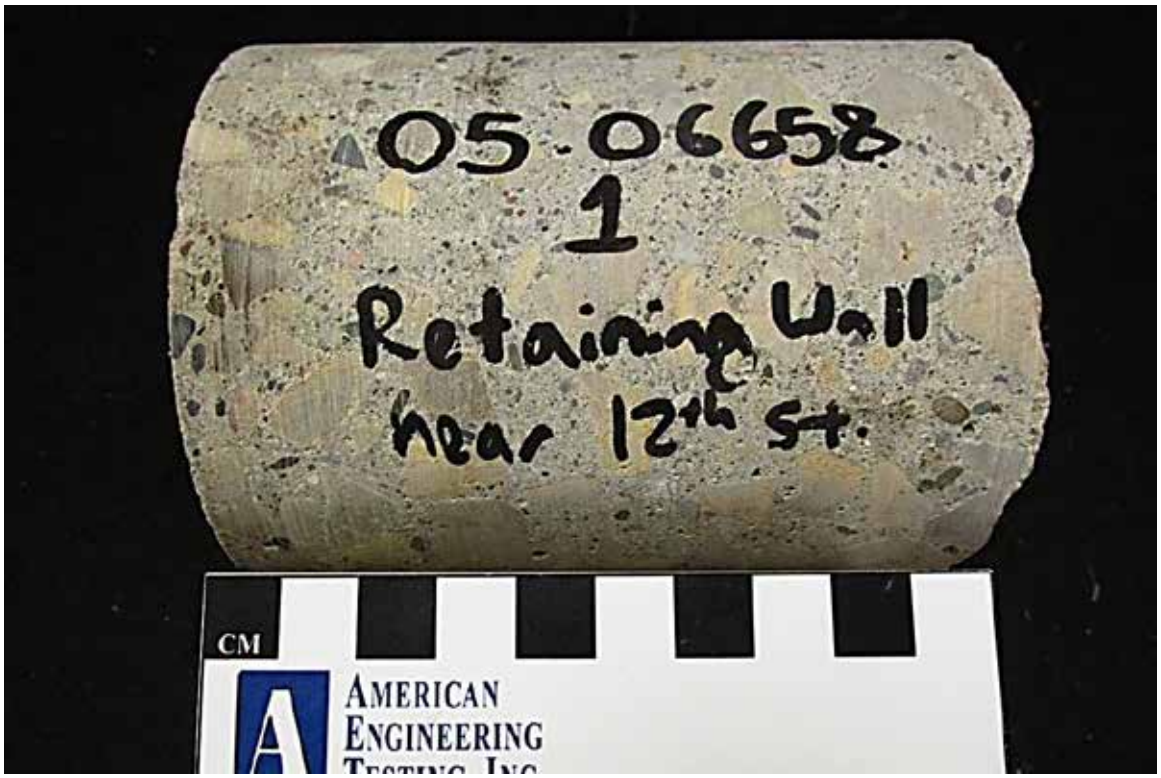
Prepared By:
American Engineering Testing, Inc.

Christine A. Tillema
Senior Petrographer
Phone: 651-659-1353
ctillema@amengtest.com

AET PROJECT NO: 05-06658 **DATE:** MARCH 29, 2016

PROJECT: PEAVEY PLAZA FOUNTAIN REHAB
NICOLLET MALL BETWEEN 11TH & 12TH STREETS SOUTH

PHOTO: 1



SAMPLE ID: 1 **DESCRIPTION:** Overall profile of the core as received, with the outer surface oriented to the left.

PHOTO: 2

SAMPLE ID: 1 **DESCRIPTION:** Outer surface of the core as received. Much of the formed outer surface has been shallowly ground away during coring.

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NICOLLET MALL BETWEEN 11TH & 12TH STREETS SOUTH

PHOTO: 3

SAMPLE ID: 2 **DESCRIPTION:** Overall profile of the core as received, with the outer surface oriented to the left.

PHOTO: 4

SAMPLE ID: 2 **DESCRIPTION:** The formed outer surface of the core as received. Minor mortar erosion has exposed many fine aggregate particles.

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NICOLLET MALL BETWEEN 11TH & 12TH STREETS SOUTH

PHOTO: 5

SAMPLE ID: 3 **DESCRIPTION:** Overall profile of the core as received, with the outer surface oriented to the left.

PHOTO: 6

SAMPLE ID: 3 **DESCRIPTION:** The outer surface of the core as received. Severe mortar erosion has exposed many coarse aggregate particles.

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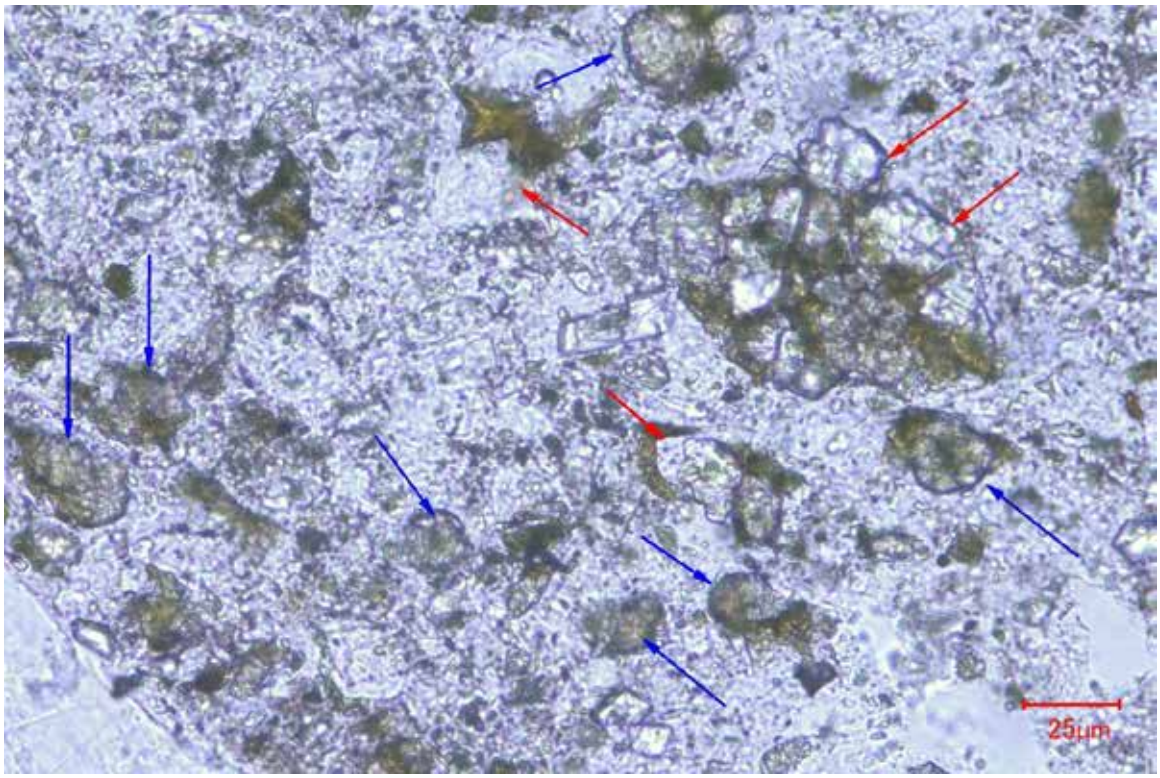
NICOLLET MALL BETWEEN 11TH & 12TH STREETS SOUTH

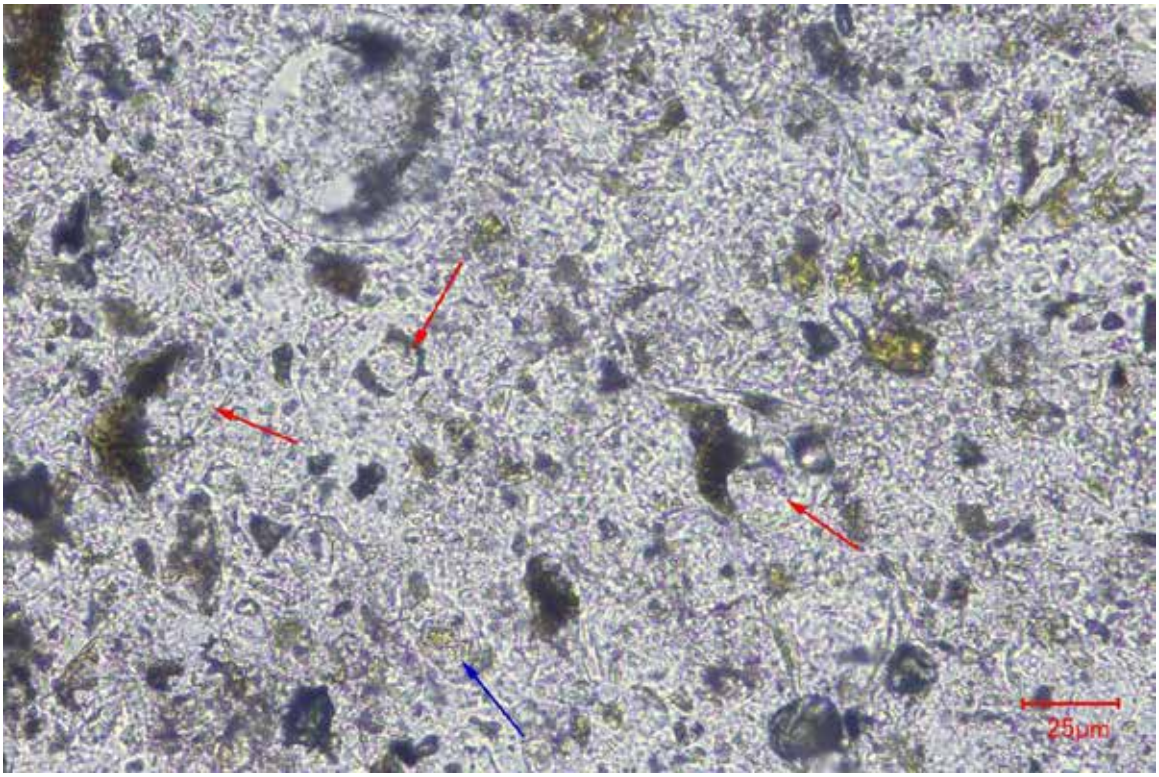
PHOTO: 7



SAMPLE ID: 1
MAG: 400x

DESCRIPTION: Moderately to fully-hydrated residual and relict alite (red arrows) and Low to moderately hydrated residual belite (blue arrows) portland cement clinker particles in a thin section of concrete paste viewed with transmitted plane-polarized light.

PHOTO: 8



SAMPLE ID: 2
MAG: 400x

DESCRIPTION: Fully-hydrated relict alite (red arrows) and a fully hydrated relict belite (blue arrow) portland cement clinker particles in a thin section of concrete paste viewed with transmitted plane-polarized light.

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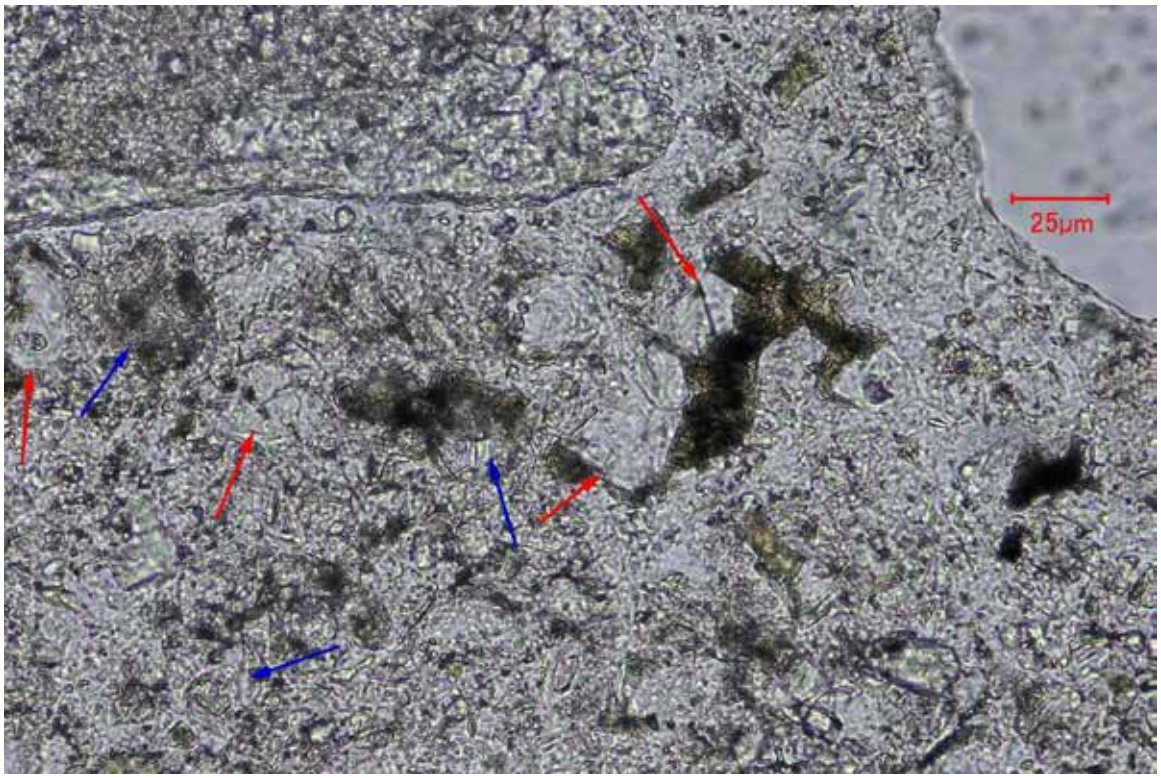
NICOLLET MALL BETWEEN 11TH & 12TH STREETS SOUTH

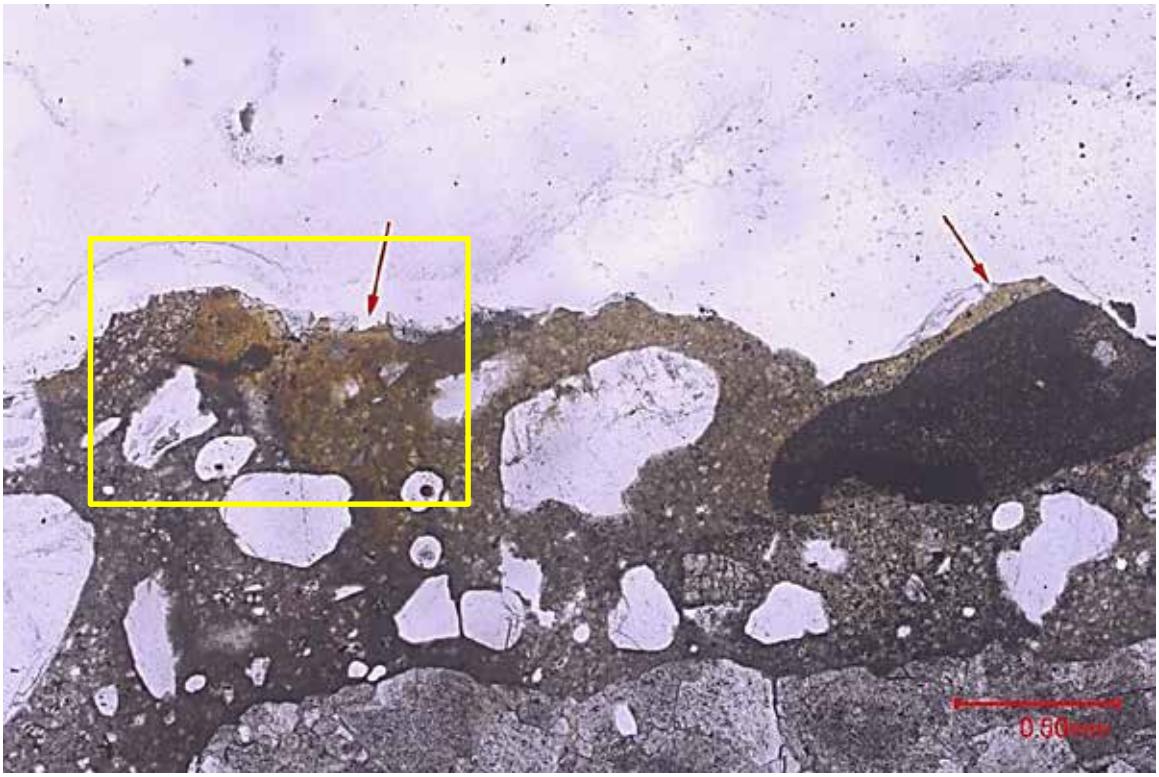
PHOTO: 9



SAMPLE ID: 3
MAG: 400x

DESCRIPTION: Fully-hydrated relict alite (red arrows) and well hydrated residual belite (blue arrows) portland cement clinker particles in a thin section of concrete paste viewed with transmitted plane-polarized light.

PHOTO: 10



SAMPLE ID: 3
MAG: 40x

DESCRIPTION: Orange-brown discoloration of the paste at the outer surface was up to 0.5 mm thick. The yellow box gives the approximate location of photos 11 and 12. Thin section of concrete viewed with transmitted plane-polarized light.

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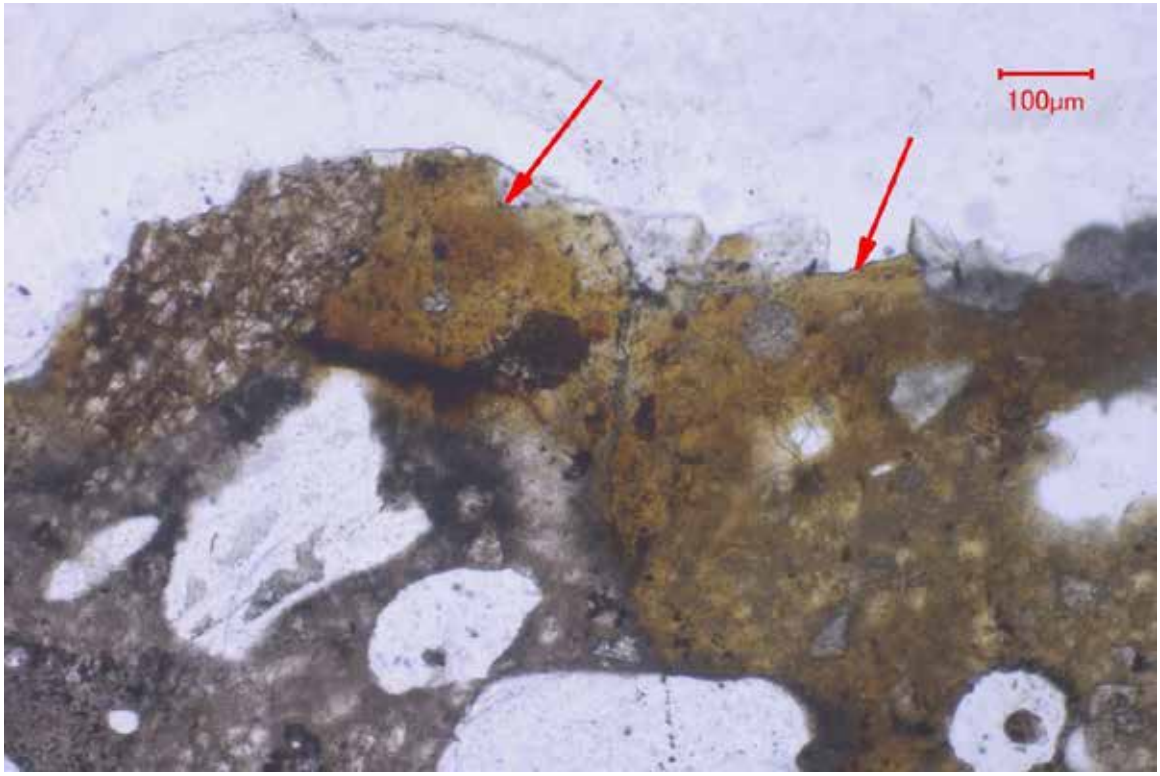
PROJECT: PEAVEY PLAZA FOUNTAIN REHAB
NICOLLET MALL BETWEEN 11TH & 12TH STREETS SOUTH

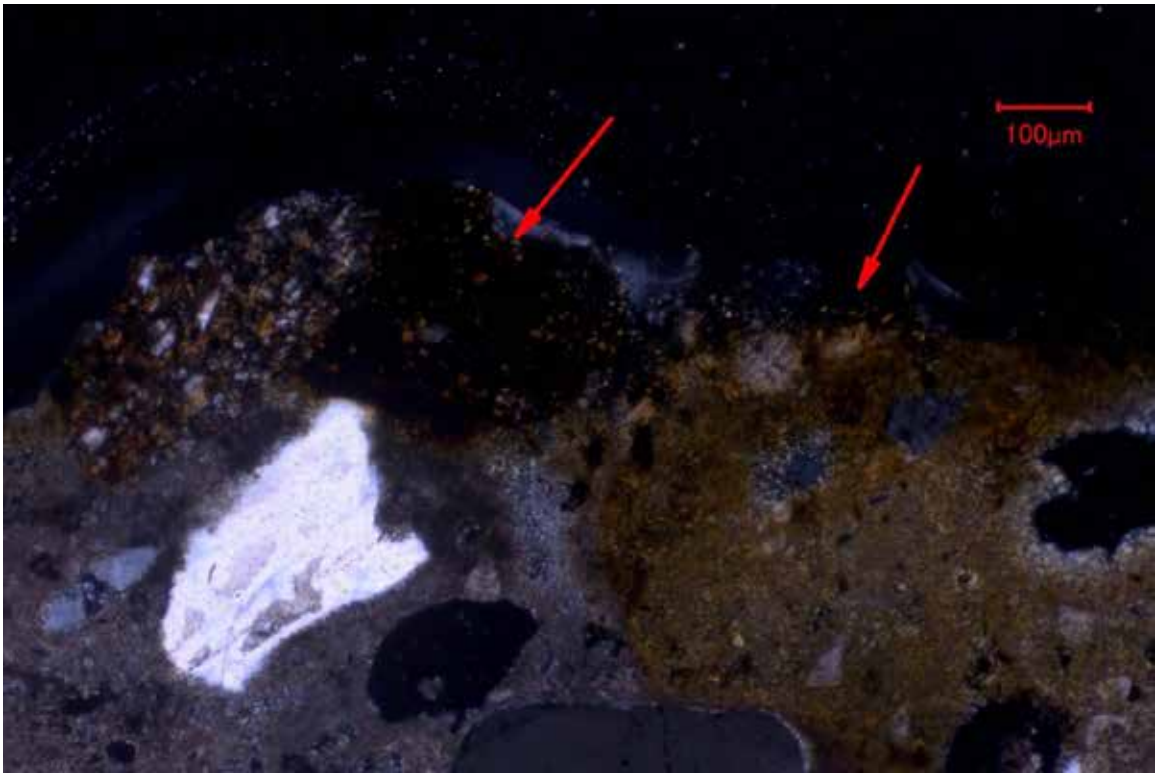
PHOTO: 11



SAMPLE ID: 3
MAG: 100x

DESCRIPTION: Magnified view of area within the yellow box in photo 10, showing stained paste. Thin section of concrete paste viewed with transmitted plane-polarized light.

PHOTO: 12



SAMPLE ID: 3
MAG: 100x

DESCRIPTION: Same area as pictured above, viewed with transmitted cross-polarized light. The top most stained paste is opaque (black). The carbonated paste beneath is stained on the right side of the photomicrograph and unstained on the left side. A layer of opaque paste is typically observed in concrete that has experienced acid attack.

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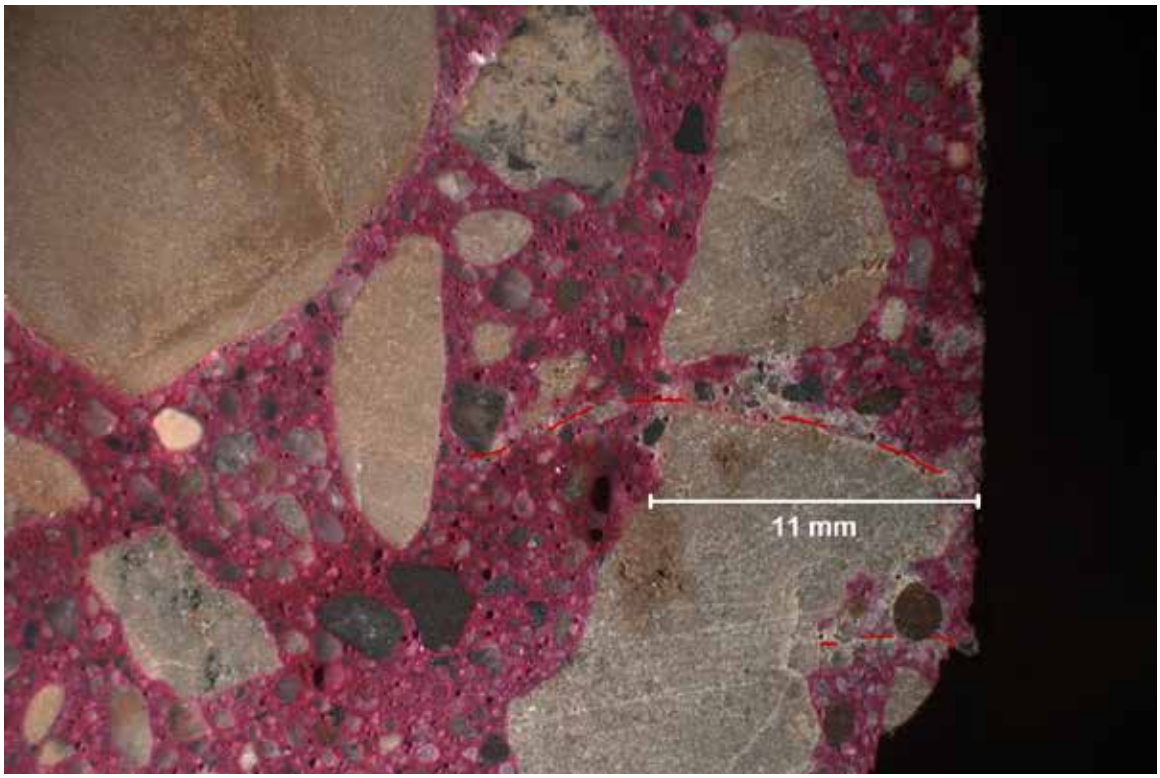
PROJECT: PEAVEY PLAZA FOUNTAIN REHAB
NICOLLET MALL BETWEEN 11TH & 12TH STREETS SOUTH

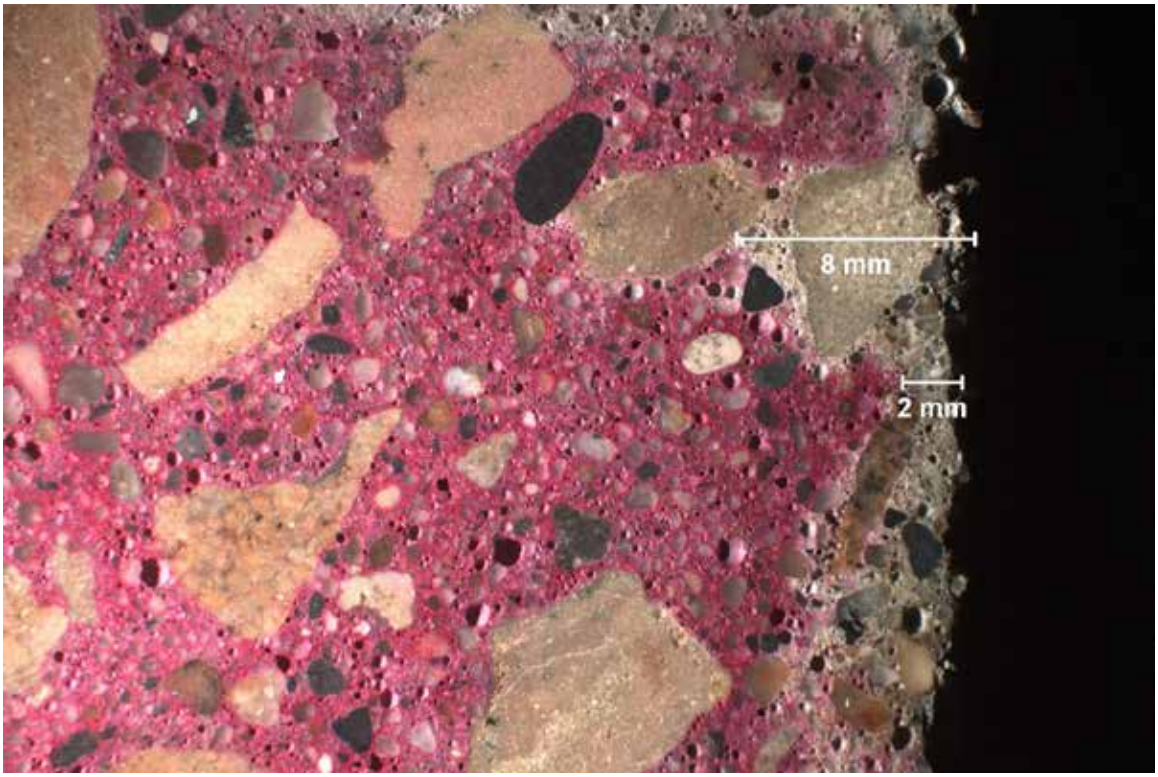
PHOTO: 13



SAMPLE ID: 1
MAG: 5x

DESCRIPTION: Carbonation (unstained paste) measured from the outer surface of the core was mostly negligible and proceeded up to 11 mm (7/16") depth along microcracking (approximated by the dashed red lines). Observed on a saw-cut and lapped profile of the sample treated with the pH indicator phenolphthalein.

PHOTO: 14



SAMPLE ID: 2
MAG: 5x

DESCRIPTION: Carbonation (unstained paste) ranged from 2 mm (1/16") to 8 mm (5/16") depth from the outer surface of the sample. Observed on a saw-cut and lapped profile of the concrete treated with the pH indicator phenolphthalein.

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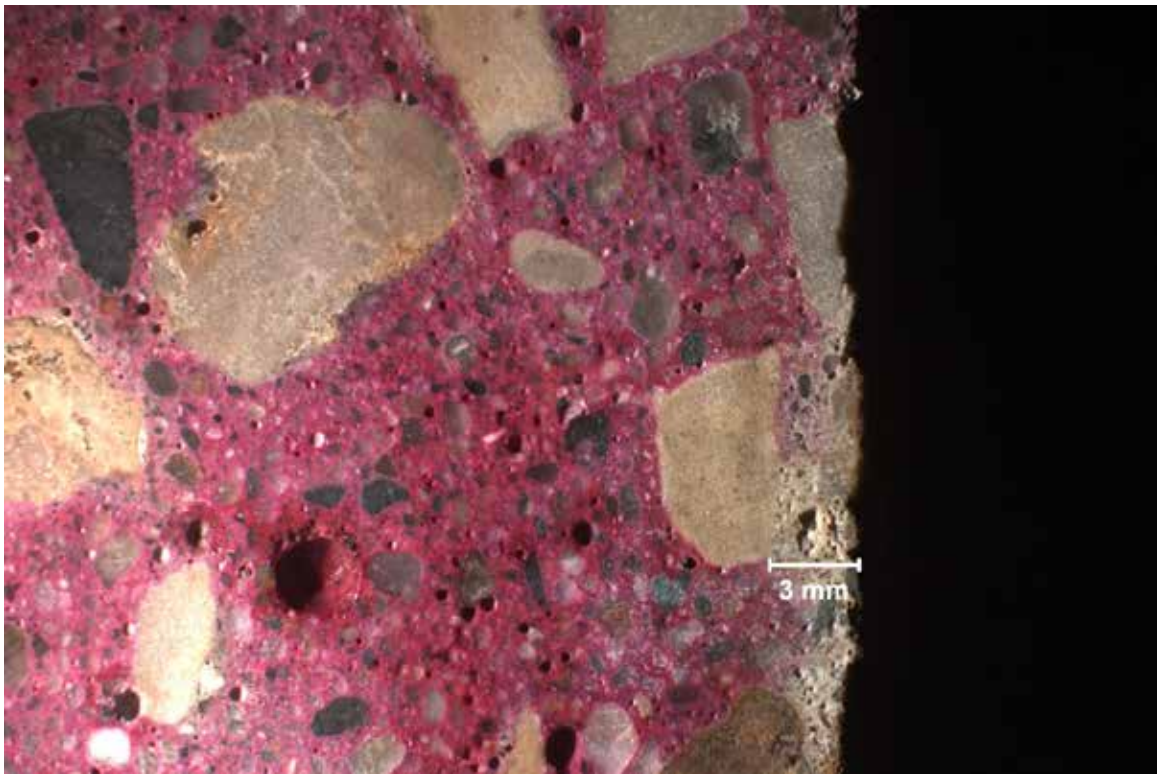
NICOLLET MALL BETWEEN 11TH & 12TH STREETS SOUTH

PHOTO: 15



SAMPLE ID: 3
MAG: 5x

DESCRIPTION: Carbonation (unstained paste) ranged from negligible to 3 mm (1/8") depth from the outer surface of the sample. Observed on a saw-cut and lapped profile of the concrete treated with the pH indicator phenolphthalein.

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SITE VISIT REPORT

PROJECT: Ground Penetrating Radar (GPR)
Peavey Plaza Fountains
Minneapolis, Minnesota

COPIES: Denita Lemmon /
Miller Dunwiddie Architecture

ON-SITE CONTACTS:
N / A

DATE: March 14. 2016
April 1, 2016
April 22, 2016

AET PROJECT NO: 05-06658

REPORT NO: 1

AET PERSONNEL: Brandon Mikelson
Dick La Fond

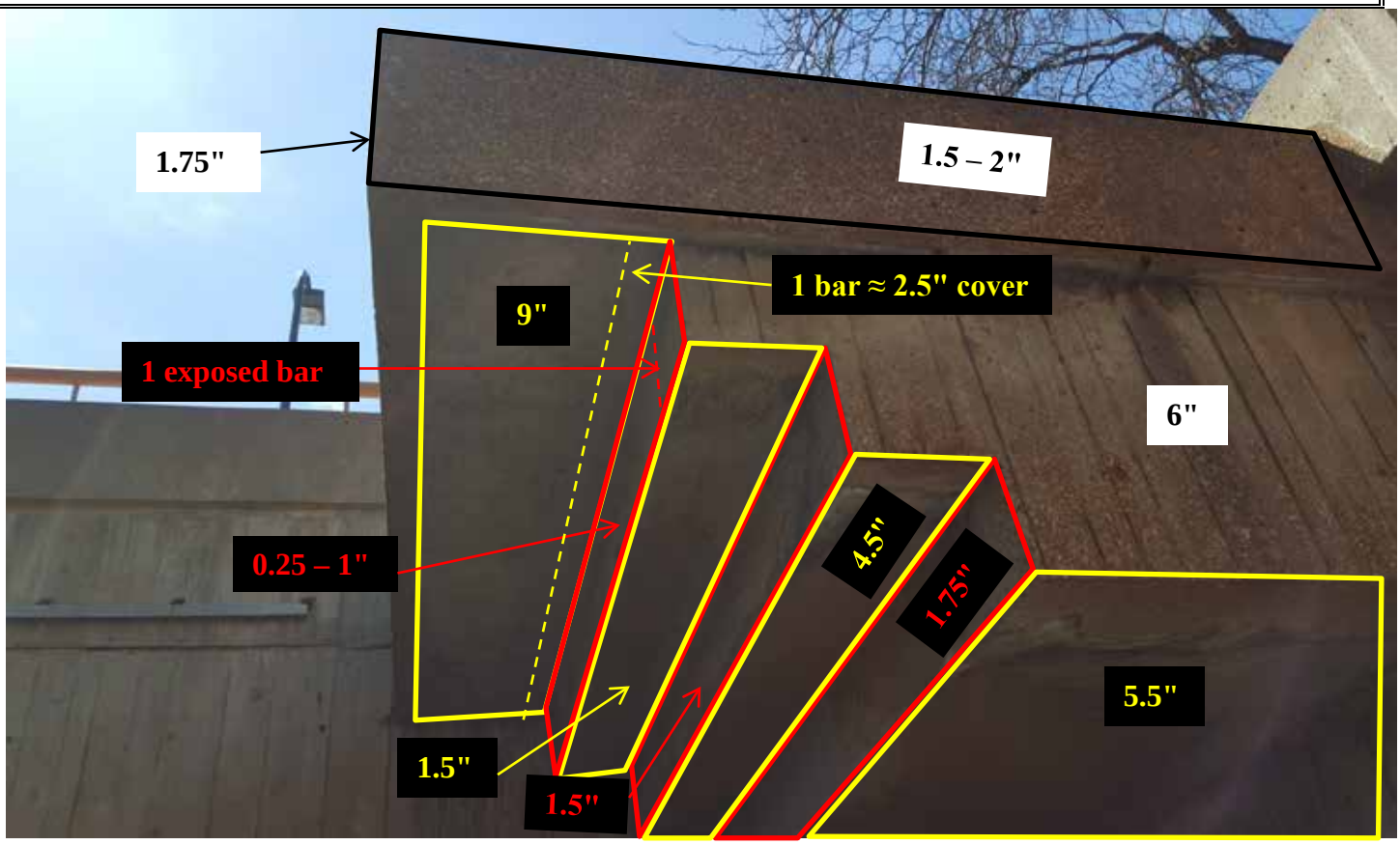
SCOPE OF WORK:
1600 MHz Antenna – Record reinforcement concrete cover of the lower, east and main fountain areas.

OBSERVATIONS:
Please see attached photo sheets for the summary of typical concrete cover in the fountains documented by the GPR equipment. Project is bordered on the north by Nicollet Avenue and to the west by 12th Street South per the project plans provided by Miller Dunwiddie.

PHOTOS
AET PROJECT NO. 05-06658

Photo 1: Facing Nicollet Avenue. The overhangs are numbered from 1 to 5 in the following photos depicting concrete cover.

Photo 2: Overhang 1 – Facing 12th Street South.



PHOTOS
AET PROJECT NO. 05-06658

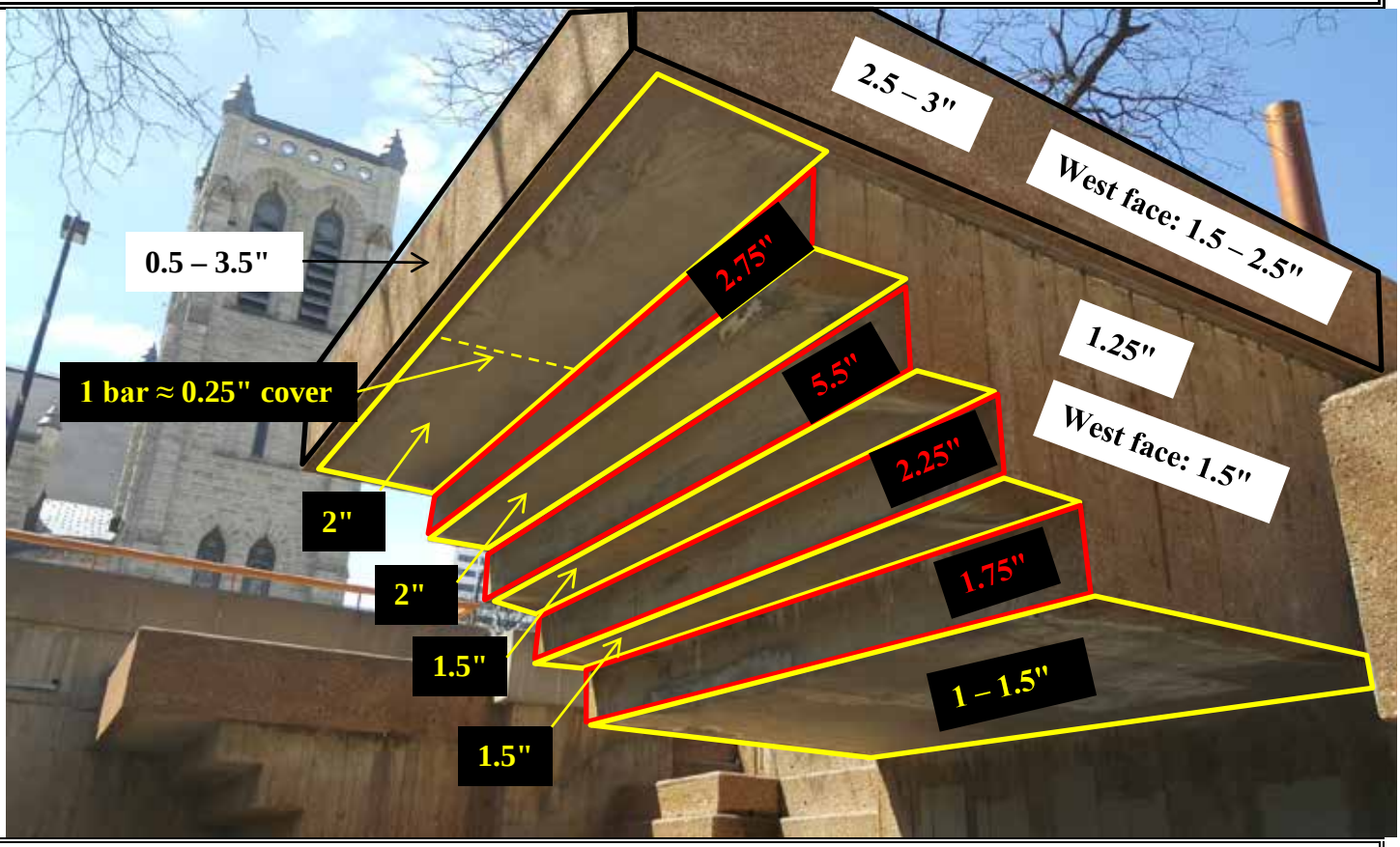
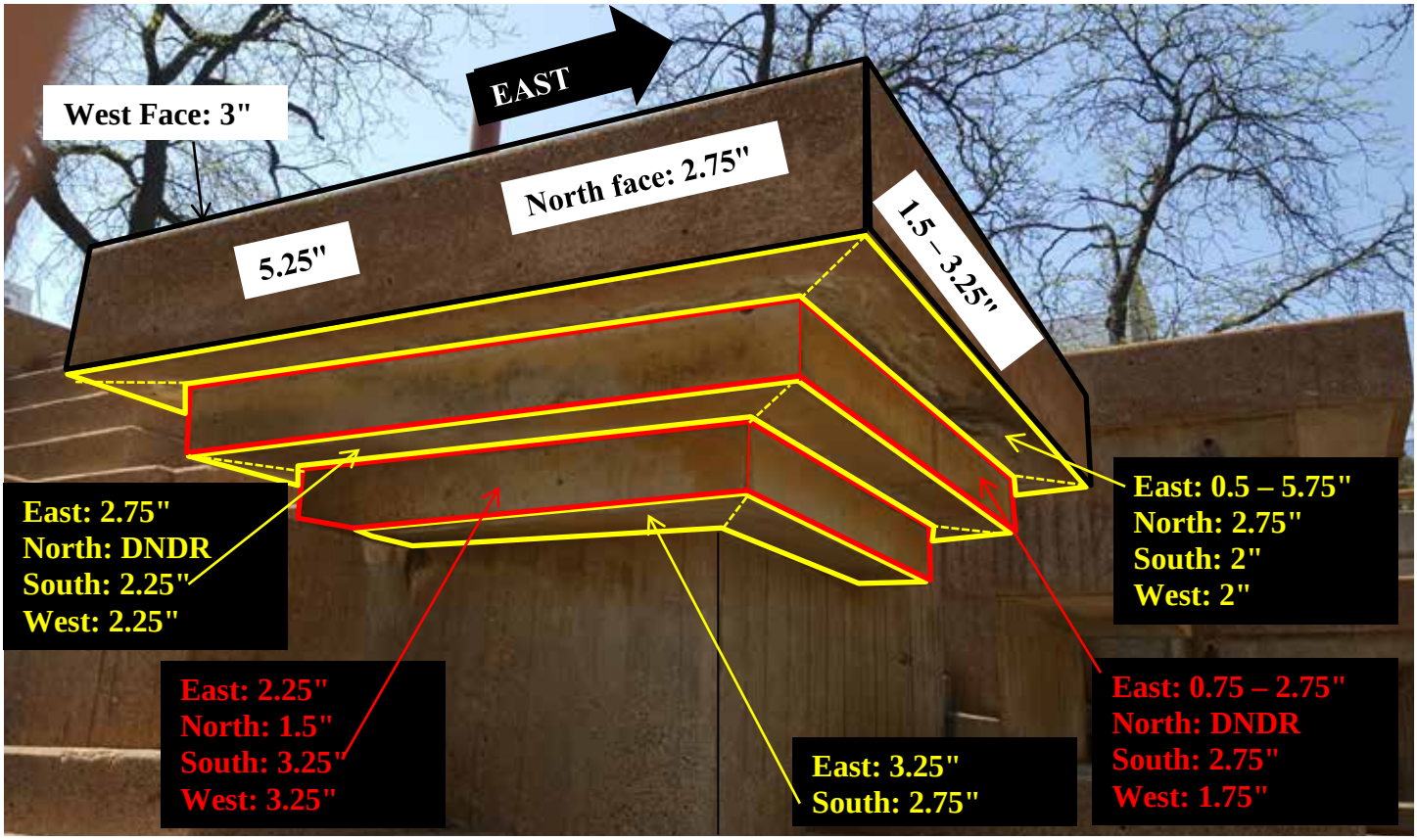


Photo 3: Overhang 2 – Facing 12th Street South

Photo 4: Overhang 3 – Facing Nicollet Avenue. DNDR – Did Not Detect Reinforcement



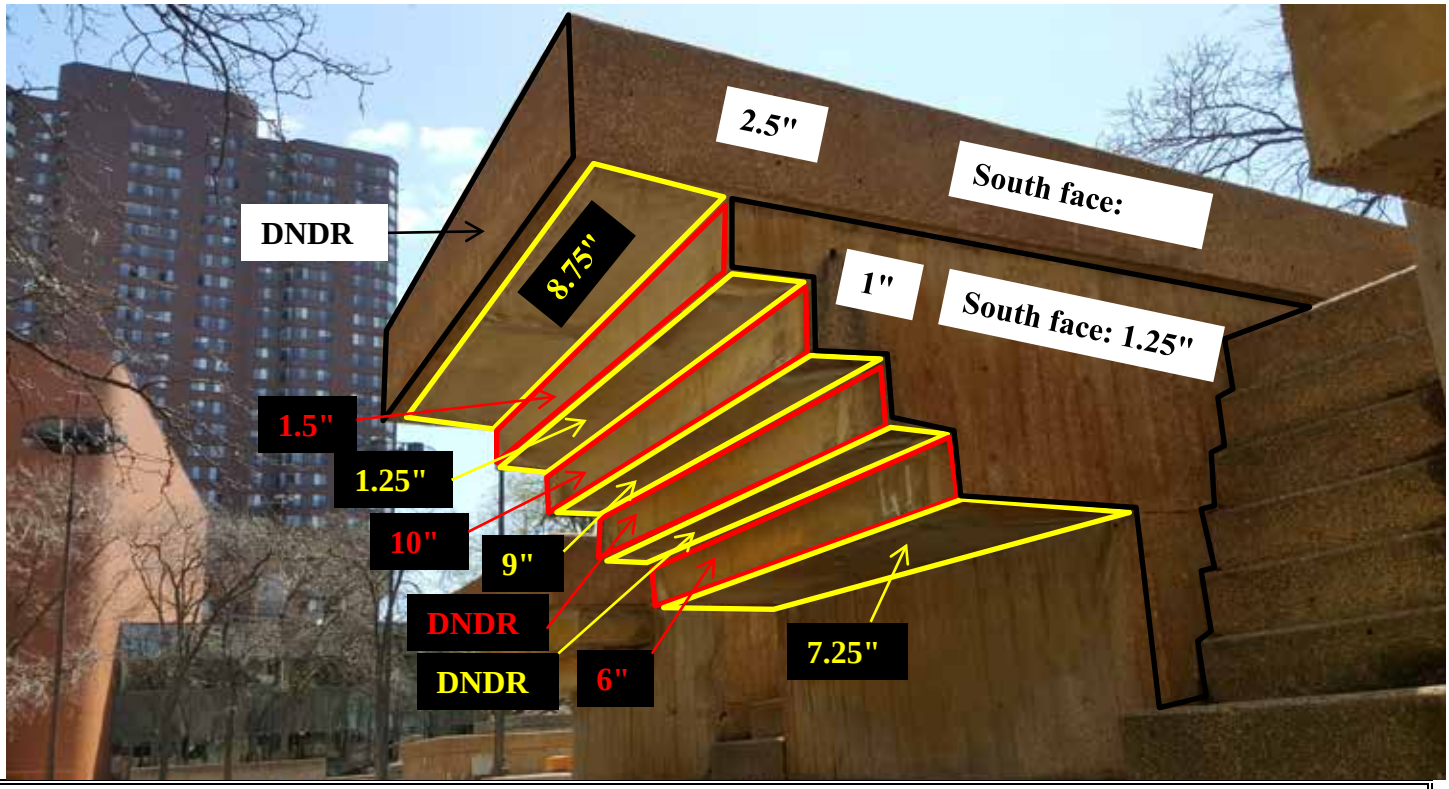
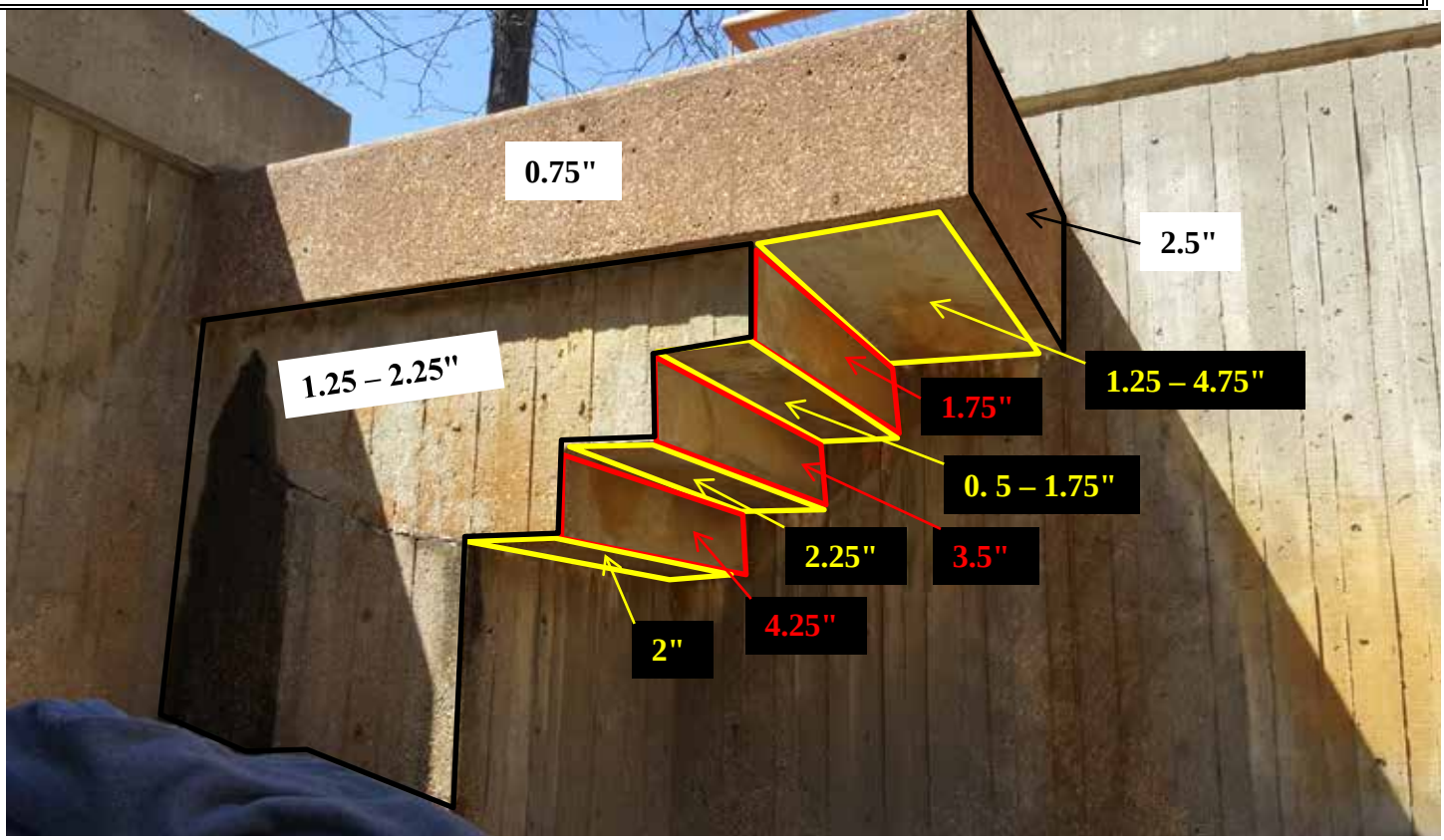


Photo 5: Overhang 4 – Facing Marquette Avenue. DNDR – Did Not Detect Reinforcement

Photo 6: Overhang 5 – Facing Nicollet Avenue.



PHOTOS
AET PROJECT NO. 05-06658

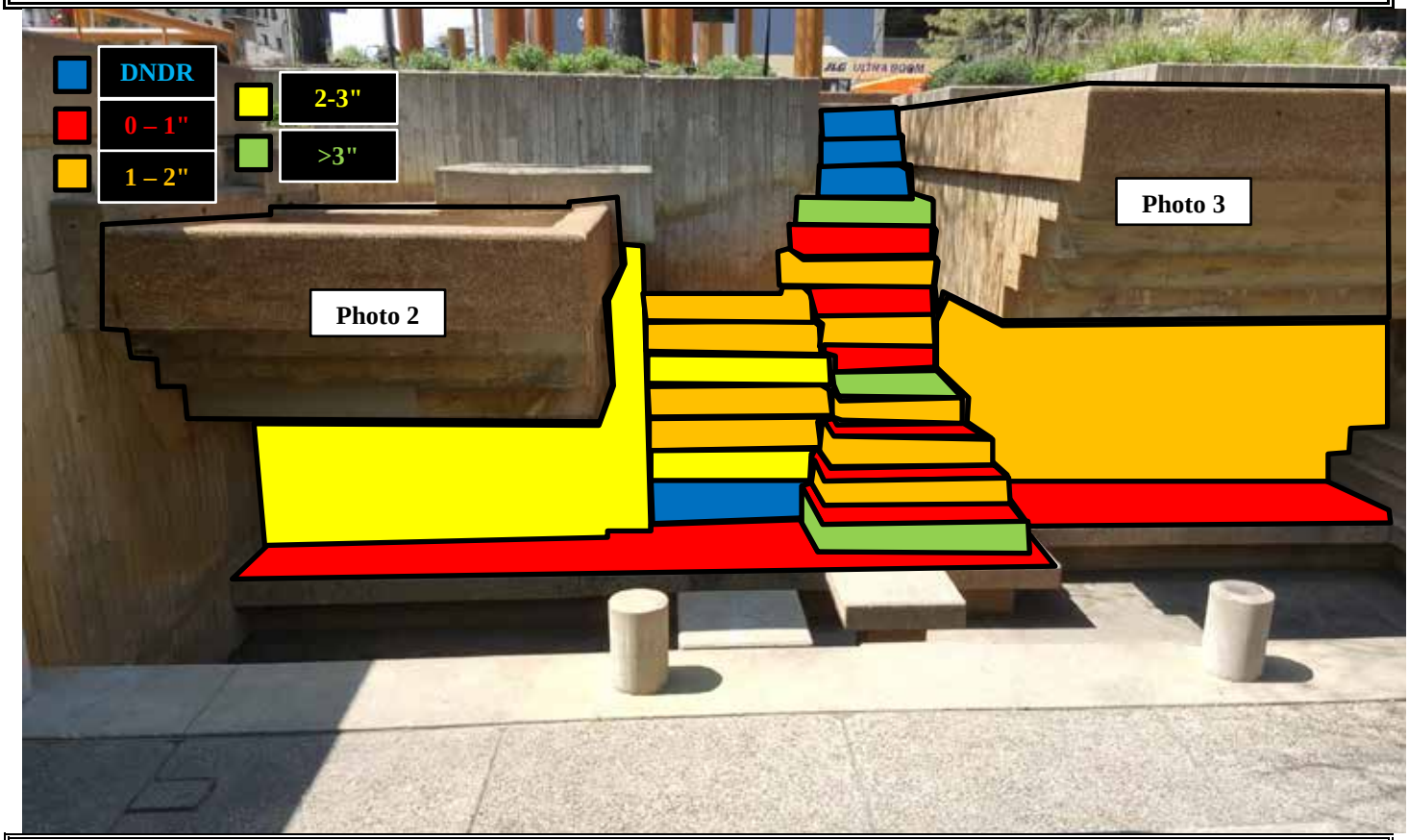


Photo 7: Facing Nicollet Avenue towards the southwest "fountain steps". Did Not Detect Reinforcement in areas shaded blue.

Photo 8: Facing Nicollet Avenue toward the south "fountain steps" near the southeast corner of the fountains.

PHOTOS
AET PROJECT NO. 05-06658

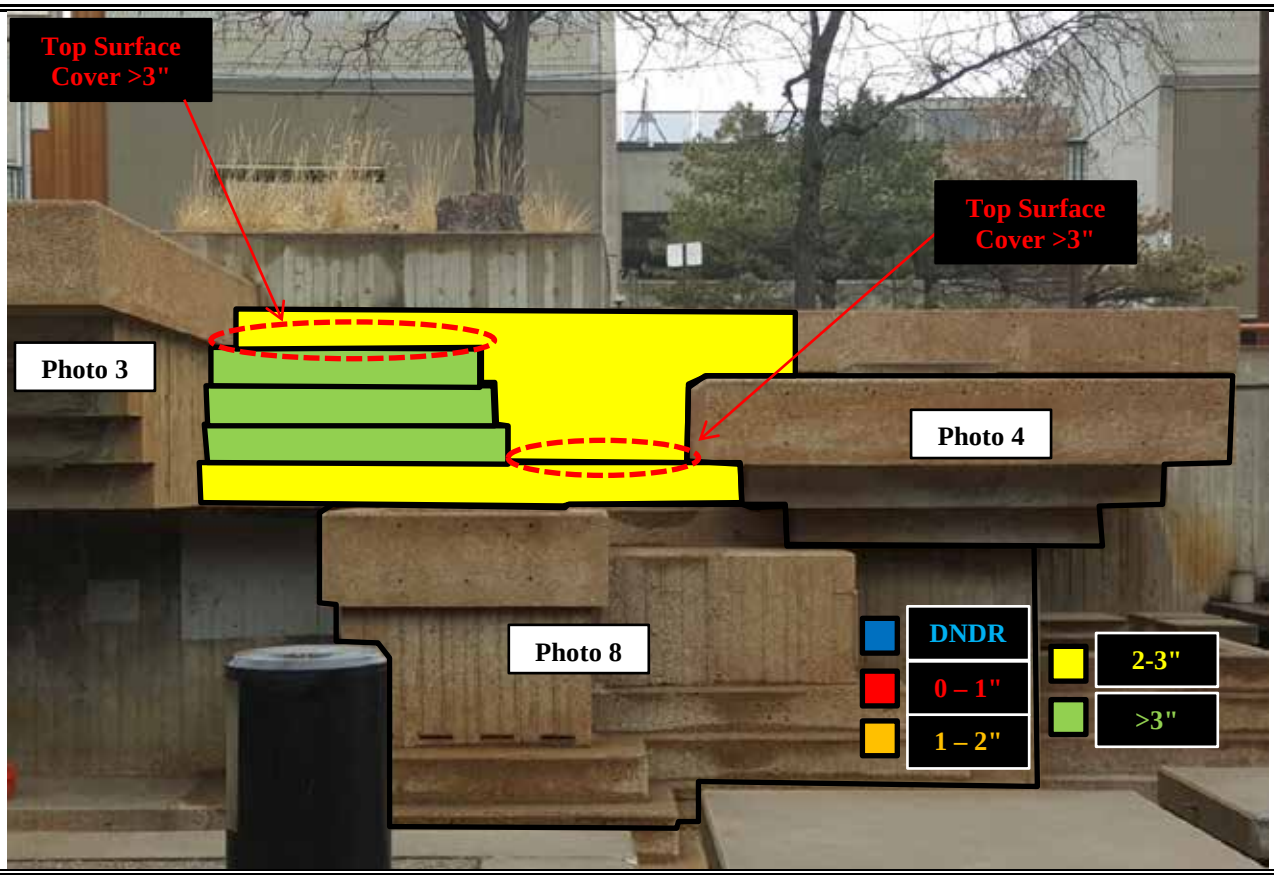
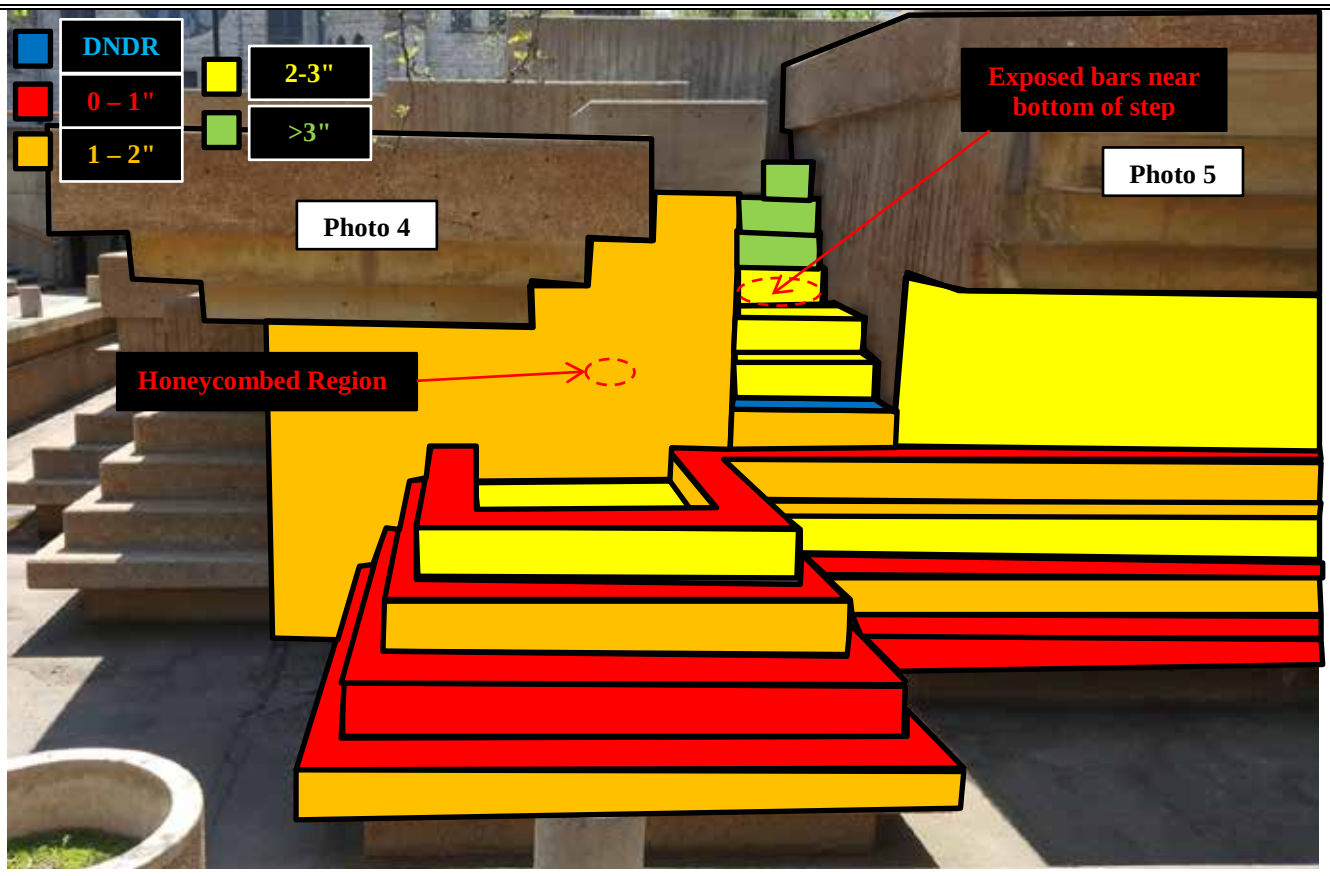


Photo 9: Top of south "fountain steps" in southeast corner of fountain.

Photo 10: Facing 12th Street South towards the east "fountain steps" in the southeast corner.



PHOTOS
AET PROJECT NO. 05-06658

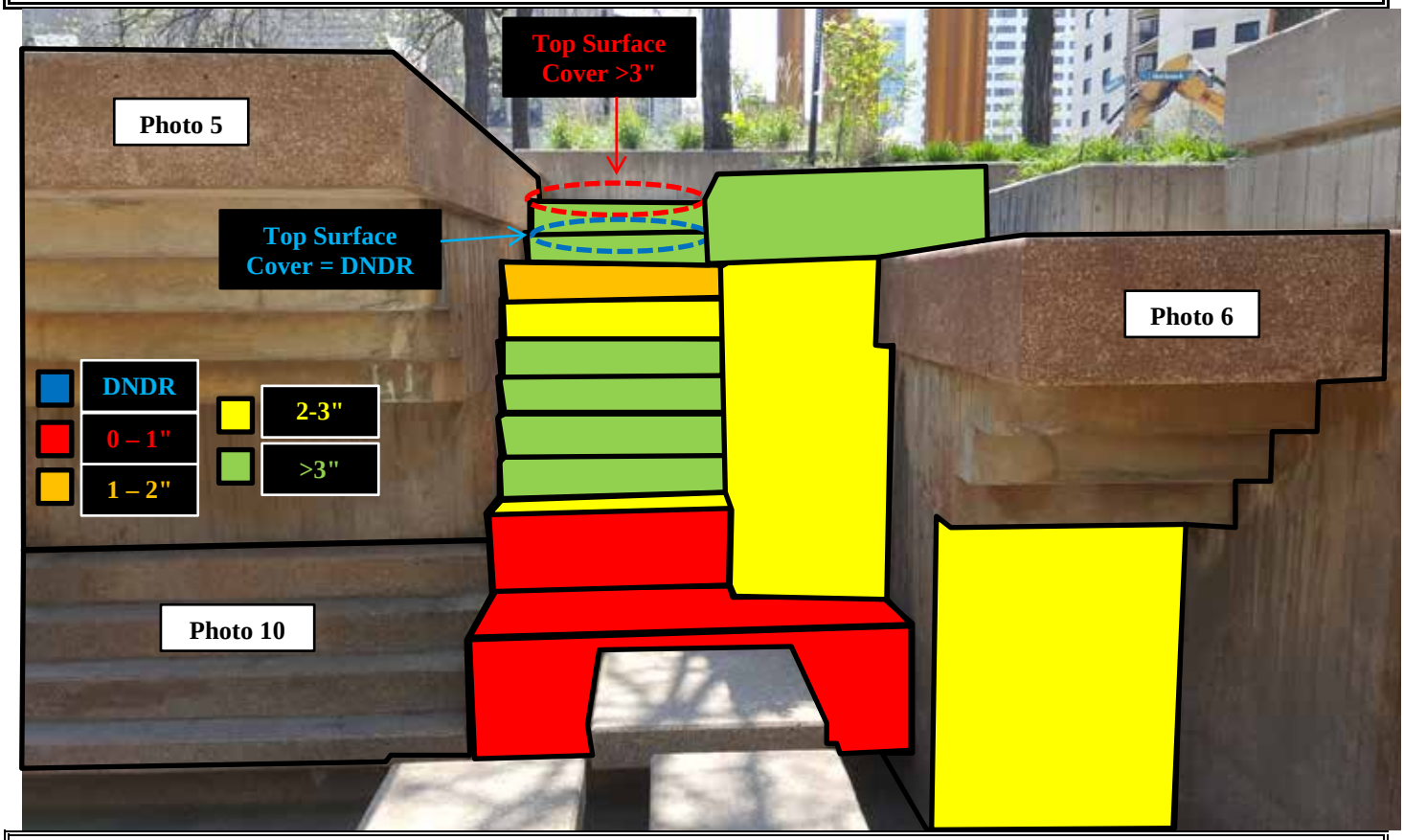
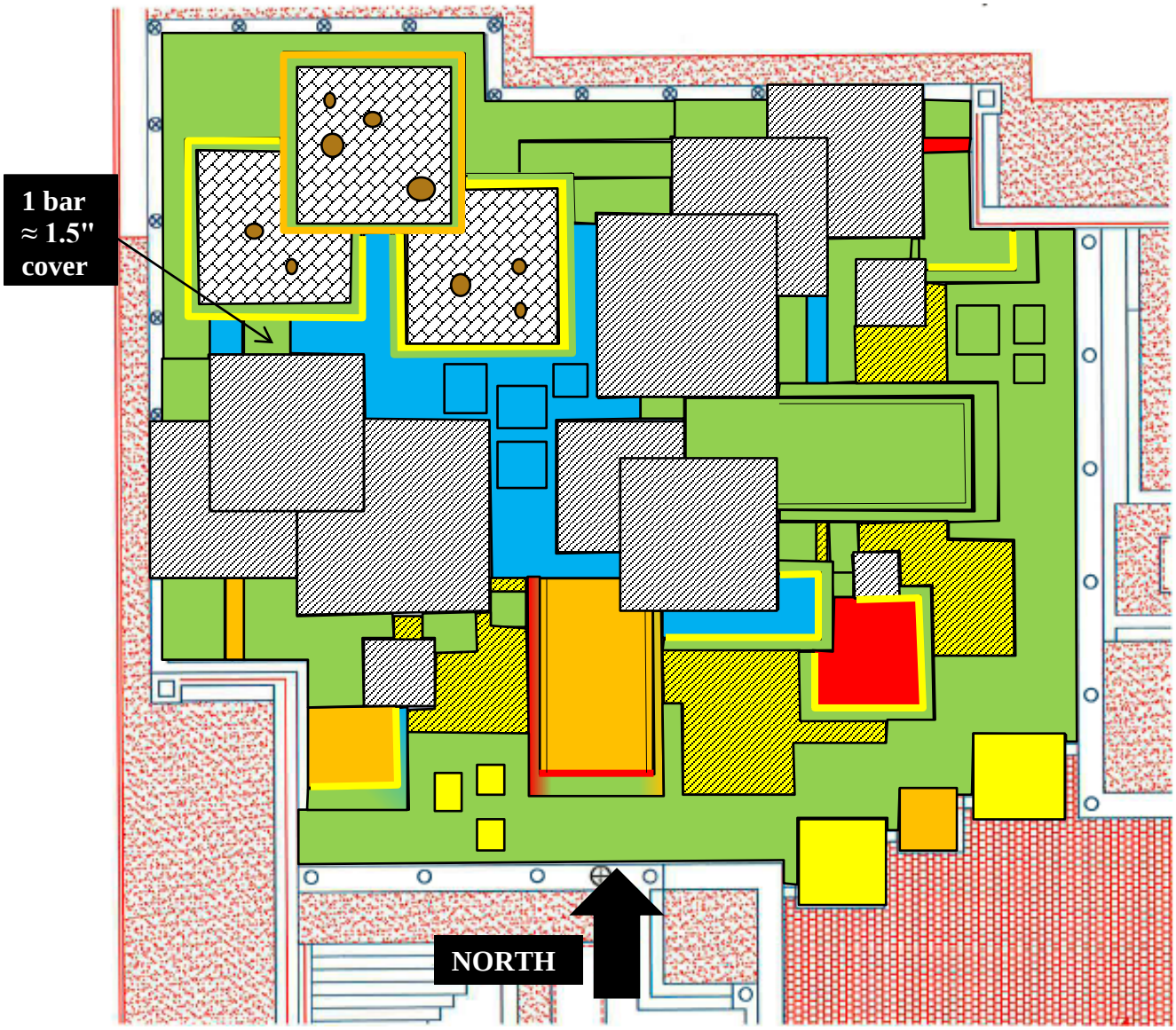


Photo 11: Facing 12th Street South at the northeast "fountain steps" in the northeast corner.

PHOTOS
AET PROJECT NO. 05-06658



Top Cover Key:

- DNDR
- 0 – 1"
- 1 – 2"
- 2-3"
- >3"
- DNR (Planter)
- RCPP

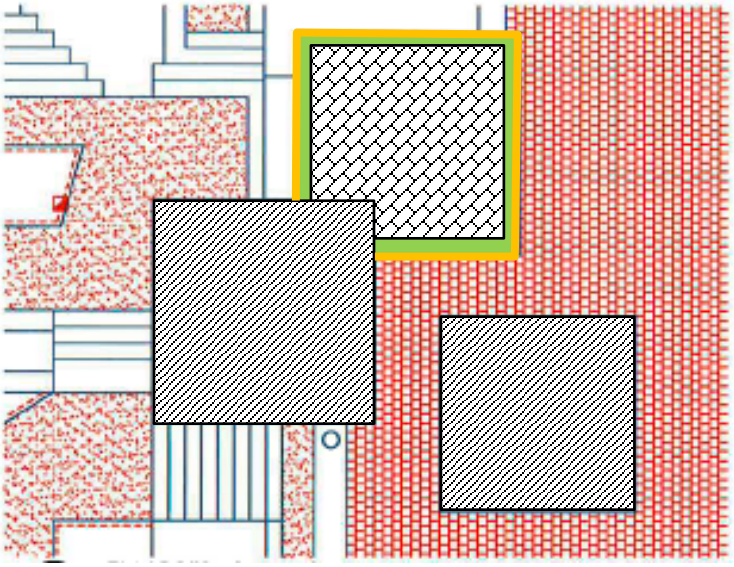
Side Cover Key:

- DNDR
- 0 – 1"
- 1 – 2"
- 2-3"
- >3"

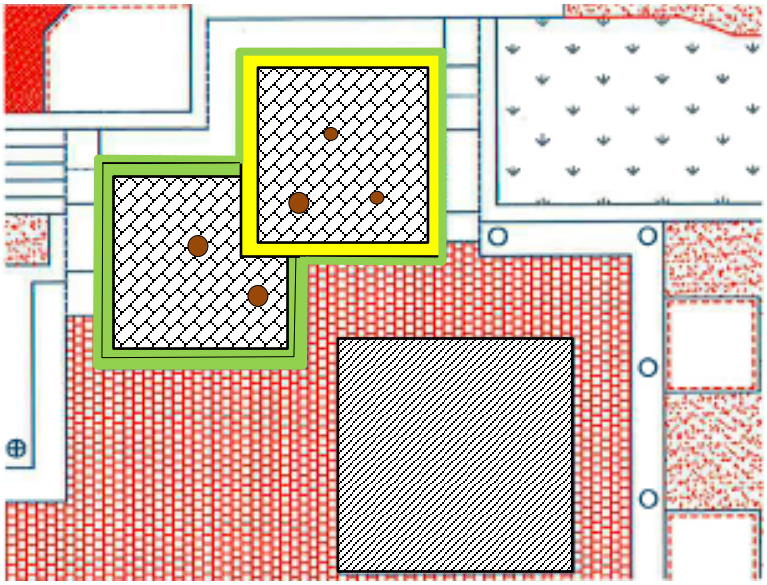
Top View Diagram – Main Fountains: DNDR – Did Not Detect Reinforcement, DNR – Did Not Radar, RCPP – Reinforcement Cover in Previous Photos

PHOTOS
AET PROJECT NO. 05-06658

Lower Fountains



East Fountains



Top Cover Key:

- DNDR
- 0 – 1"
- 1 – 2"
- 2-3"
- >3"
- DNR (Planter)
- RCPP

Side Cover Key:

- DNDR
- 0 – 1"
- 1 – 2"
- 2-3"
- >3"

Top View Diagram – East & Lower Fountains: